04-533

U.S./CA TRDP PROJECT ARRANGEMENT NO. U.S./CA-A-98-0027

BETWEEN

THE DEPARTMENT OF DEFENSE

OF THE UNITED STATES OF AMERICA

AND THE

DEPARTMENT OF NATIONAL DEFENCE OF CANADA

CONCERNING

IMPROVED PERSONAL BALLISTIC PROTECTION

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SECTION I

INTRODUCTION

This Project Arrangement (PA) hereby establishes Improved Personal Ballistic Protection as a Project in accordance with the Memorandum of Understanding between the Department of Defense of the United States of America and the Department of National Defence of Canada Concerning Technology Research and Development Projects, 29 August 1996.

SECTION II

DEFINITION OF TERMS AND ABBREVIATIONS

DYNA2D/3D - Dynamic Finite Element Code - Canada.

V50 - The velocity where 50% of projectiles are expected to defeat an armor system and 50% are defeated.

Vr - Residual Velocity.

SECTION III

OBJECTIVES

3.1 The objectives of the Improved Personal Ballistic Protection Project are:

3.1.1. The development/assessment of advanced armor materials and systems that protect against ballistic threats such as fragments, bullets and flechettes and that also provide adequate blunt trauma protection (reduced behind armor effects);

3.1.2. The improvement of analytical models and test methodologies for evaluating ballistic performance and behind armor effects;

3.1.3. The integration of various materials to achieve enhanced performance;

SECTION IV

SCOPE OF WORK

4.1 The following tasks will be undertaken under this PA:

4.1.1. Identify and/or develop advanced ballistic protective materials for personal body armor from industry sources or government laboratories.

4.1.2. Conduct material performance evaluation studies and develop appropriate databases.

4.1.3. Develop improved analytical/numerical models for the prediction of the mechanics of armor materials under the ballistic impact and improve test and test techniques for the evaluation of armor materials.

SECTION V

SHARING OF TASKS

5.1 The sharing of tasks will be as follows:

5.1.1 The DOD will:

5.1.1.1 Provide project background information on:

5.1.1.1.1 fracture mechanics and fragmentation of armor materials;

5.1.1.1.2 composite and textile materials, blunt trauma and behind armor effects;

5.1.1.1.3 ballistic protection of transparent, composite and textile armor materials currently under consideration;

5.1.1.2 Develop improved estimates of V50, Vr;

5.1.1.3 Conduct obliquity, and tungsten projectile impact studies;

5.1.1.4 Evaluate resin (composite) systems for effect of resin, geometry, and lay-up on ballistic protective performance;

5.1.1.5 Evaluate and compare the ballistic performance of unidirectional textile materials, felts and fabrics;

5.1.1.6 Conduct studies on size effects, edge effects, and spall covers for bullet resistant armor (ceramic armor materials);

5.1.1.7 Extend fabric impact model to include fabric decrimping, and analytical model for small arms protection, and contribution of resin system to impact performance;

5.1.2 The DND will:

5.1.2.1 Provide project background information on:

5.1.2.1.1 fracture mechanics and fragmentation of armor materials;

5.1.2.1.2 composite and textile materials, blunt trauma and behind armor effects;

5.1.2.1.3 ballistic protection of transparent, composite and textile armor materials currently under consideration;

5.1.2.2 Study the effect of the armor backing material on ballistic performance for various armor systems;

5.1.2.3 Conduct studies to evaluate the performance (ballistic, optical, and impact) of current commercial eye/face shields systems;

5.1.2.4 Study and compare the damage mechanisms of various composite systems;

5.1.2.5 Evaluate the ballistic performance of fine denier fabric systems and hybrid armor systems;

5.1.2.6 Conduct study on small arm protective plate size effects on soldier survival probabilities, evaluate novel ceramic plate systems against armor piercing projectiles;

5.1.2.7 Enhance the DYNA2D/3D (Canada) material models for textile, ceramic and composite armor systems; Develop and improve an engineering model to evaluate the penetration resistance of composite armors. Review revisions to the Casualty Reduction Assessment (United States) model;

5.1.2.8 Improve the instrumented test surrogate to measure behind armor effects from non-penetrating fragments and bullets impact.

5.1.2.9 Conduct studies on the ballistic trauma attenuation of various personnel systems.

5.1.3 DOD and DND will jointly:

5.1.3.1 Compare the ballistic performance requirements of respective personal armor systems.

5.1.3.2 Develop statistical measures of performance and conduct fragment shape studies.

5.1.3.3 Identify material flexibility requirements and develop appropriate test methods.

5.1.3.4 Review small arms plate durability methodology and conduct durability field tests.

5.1.3.5 Evaluate the performance of novel composite materials against fragments/bullets.

5.1.3.6 Evaluate and compare the ballistic performance of unidirectional textile materials, felts, fabrics.

5.1.3.7 Conduct studies to evaluate ceramic/backing ratios, ceramic confinement, and identify affordable ceramic materials.

5.1.3.8 Review, compare, and exchange numerical models and validation techniques.

5.1.3.9 Conduct joint studies for improving the measurement methods and injury criteria for personnel armor systems.

5.1.3.10 Exchange of data on anti-flechette armor systems evaluated.

5.1.3.11 Conduct progress reviews of Project Arrangement tasks as often as desired by either Project Officer but as a minimum at least once a year.

5.1.3.12 Jointly prepare a final report detailing the key findings and conclusions of this Improved Personal Body Armor PA.

SECTION VI

BREAK DOWN AND SCHEDULE OF TASKS

Task	Start	End
Identify advanced ballistic protective materials	Y1	Y2
Identify relevant threats and threats levels	Y1	Y2
Compare, develop and improve ballistic testing methods	Y1	Y4
Develop and improve analytical methods for performance evaluation	Y2	Y4
Compare and improve personnel protection related numerical models	Y1	Y4
Conduct studies and evaluate test methods related to behind armor blunt trauma	Y1	Y4
Integrate, field and laboratory test new materials	Y4	Y5
Prepare Final Report	Y5	Y5

SECTION VII

MANAGEMENT

7.1 Project Officers:

7.1.1 U.S. PO: Title/Position:

Mr. Philip Cunniff
Research Mechanical Engineer
Natick Soldier Center
ATTN: SSCNC-IB
Natick, MA 01760-5019

7.1.2 CA PO: Title/Position:

Mr. Daniel Bourget
Defence Scientist

Defence Research Establishment
Valcartier
2459 Pie-XI Blvd. North
Val-Belair QC
G3J 1X5 Canada

SECTION VIII

FINANCIAL ARRANGEMENTS

8.1 The financial contributions of the Participants will be:

8.1.1 For the DOD, the financial contribution for this PA is estimated to be $1.5 Million U.S. dollars.

8.1.2 For the DND, the financial contribution for this PA is estimated to be $2.0 Million Canadian dollars over the 5 year program.

8.2 The non-financial contributions of the Participants will be:

8.2.1 For the DOD, the non-financial contribution for this PA is estimated to be $268,000 U.S. dollars.

8.2.2 For the DND, the non-financial contribution for this PA is estimated to be $840,000 Canadian dollars over the 5 year program.

8.3 The total contributions of the Participants will be:

8.3.1 For the DOD, the total contribution for this PA is estimated to be $1.77 Million U.S. dollars.

8.3.2 For the DND, the total contribution for this PA is estimated to be $2.84 Million Canadian dollars over the 5 year program.

8.4 Cooperative efforts of the Participants over and above jointly agreed tasks set forth in the SCOPE OF WORK, SHARING OF TASKS and FINANCIAL ARRANGEMENTS articles will be subject to amendments to this PA or signature of a new PA.

SECTION IX

LEVEL OF CLASSIFICATION

9.1 The highest level of Classified Information exchanged under this PA is: SECRET.

SECTION X

PRINCIPAL ORGANIZATIONS INVOLVED

10.1 For the United States:

U.S. Army Soldier and Biological Chemical Command
Natick Soldier Center
Natick, MA 01760-5019

U.S. Army Research Laboratory
Aberdeen Proving Ground, MD 21005

10.2 For Canada:

Defence Research Establishment
Valcartier
2459 Pie-XI Blvd. North
Val-Belair QC G3J 1X5
Canada

Directorate Soldier Systems Program
Management (DSSPM2)
National Defence Headquarters
MGen G.R. Pearkes Blvd
Ottawa, Ontario, Canada, K1A OK2

SECTION XI

LOANS OF MATERIALS, SUPPLIES, AND EQUIPMENT

11.1 The following Project Equipment may be transferred by the providing Participant to the receiving Participant:

PROVIDING PARTICIPANT	RECEIVE PARTICIPANT	QUANT.	DESCRIPTION	STOCK NUMBER	APPROX. VALUE
DOD	DND	30	Thin Boron Carbide/ Spectrashield Armor	N/A	$200 Ea
DOD	DND	30	Aluminum Oxide S2 Glass For Armor	N/A	$200 Ea
DOD	DND	30	Bullet and Fragmentation Protective Armor Systems	N/A	$200 Ea
DOD	DND	20	Ballistic Materials (fabric, ceramics, composite targets, projectiles (fragments, bullets)	N/A	$300 Ea
DND	DOD	20	Targets (end items)	N/A	$300 Ea
DND	DOD	20	Bullet Resistant Plates	N/A	$300 Ea
DND	DOD	20	Fragment Resistant Jackets	N/A	$300 Ea
DND	DOD	20	Ballistic Eyewear/Visors	N/A	$300 Ea
DND	DOD	20	Ballistic Helmets	N/A	$300 Ea
DND	DOD	20	Ballistic Materials (fabric, ceramics, composite targets, projectiles (fragments, bullets)	N/A	$300 Ea

11.2 The providing Participant will transfer the Project Equipment listed above for the duration of the PA.

11.3 The providing Participant will deliver the Project Equipment at a location to be determined by the Providing Participant. Custody of the Project Equipment will pass from the providing Participant to the receiving Participant at the time of receipt. Any further transportation is the responsibility of the receiving Participant unless otherwise specified.

11.4 The providing Participant will furnish the receiving Participant such information as is necessary to enable the Project Equipment to be used.

11.5 The receiving Participant will inspect and inventory the Project Equipment upon receipt. The receiving Participant will also inspect and inventory the Project Equipment prior to its return to the providing Participant unless the Project Equipment is consumed in accordance with Paragraph 11.7.

11.6 Upon expiration or termination of the transfer period specified in paragraph 11.2 (taking in account any approved extension by the providing Participant), the receiving Participant will return the nonconsumable Project Equipment to the providing Participant. If the Project Equipment is lost, unintentionally destroyed, or damaged beyond the repair while in the custody of the receiving Participant, the receiving Participant will issue a certificate of loss/destruction/ irreparable damage to the providing Participant and pay the replacement value specified in paragraph 11.1.

11.7 It is intended that the receiving Participant will consume the Project Equipment specified in paragraph 11.1. If this does occur, the receiving Participant will provide written notice of its consumption to the providing Participant. In the event consumption does not occur prior to the end of the transfer period specified in paragraph 11.2, the receiving Participant will return the Project Equipment to the providing Participant. If the Project Equipment is lost, unintentionally destroyed, or damaged beyond repair prior to intended consumption while in the custody of the receiving Participant, the receiving Participant will issue a certificate of loss/destruction/irreparable damage to the providing Participant and pay the replacement value specified in paragraph 11.1.

SECTION XII

ENTRY INTO EFFECT, DURATION AND TERMINATION

This Improved Personal Body Armor PA, a Project under the Memorandum of Understanding between the Department of Defense of the United States of America and the Department of National Defence of Canada for Technology Research and Development Projects, will enter into effect upon its signature, and will remain in effect for five (5) years unless terminated by either Participant. It may be extended by mutual written consent of signatories.

For the Department of Defense of the United States of America:	For the Department of National Defence of Canada:
Signature	Signature
Craig D. Hunter Name	L.J. Leggat Name
Deputy Assistant Secretary of the Army for Defense Exports and Cooperation Title	Assistant Deputy Minister (Science & Technology) Title
20 December 2002 Date	9 January 2003 Date
Arlington, Virginia Location	Ottawa, Ontario, Canada Location